Big Mysteries Survey: Physicists' Views on Cosmology, Black Holes, Quantum Mechanics, and Quantum Gravity

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Abstract

We present results from the Big Mysteries Survey, a large-scale survey conducted through the American Physical Society's *Physics Magazine* on foundational and controversial topics in contemporary physics. The survey provides a snapshot of physicists' views on issues in cosmology, black-hole physics, quantum mechanics, quantum gravity, and anthropic coincidences. A central finding is that several positions often described publicly as field-wide "consensus" views are, in practice, supported by much narrower majorities or by pluralities rather than majorities.

I. INTRODUCTION

In the summer of 2024, a survey was conducted at the Black Hole Inside Out Conference in Copenhagen to assess physicists' views on a range of ongoing controversies [1]. Eighty-five scientists responded. One year later, the authors collaborated with the American Physical Society's *Physics Magazine* on a substantially larger follow-up survey, which polled 1,675 participants from the magazine's readership and the members of the American Physical Society. The Physics Magazine survey therefore provides a broader view of attitudes within the physics community and allows comparisons with the more focused conference-based Copenhagen sample.

Taken together, the two surveys make it possible to compare views expressed in a specialist conference setting with those expressed by a much larger and more heterogeneous respondent pool. On some topics, the results are remarkably similar; on others, the differences are substantial. This paper presents the Big Mysteries Survey results, offers commentary on their interpretation, and highlights points of agreement and divergence relative to the Copenhagen survey.

To provide context for the interpretation of the response distributions, Figure 1 summarizes the respondent background information supplied in the Physics Magazine survey. This profile helps frame the results as reflecting a broad community sample with mixed career stages and research backgrounds rather than a single subdiscipline.

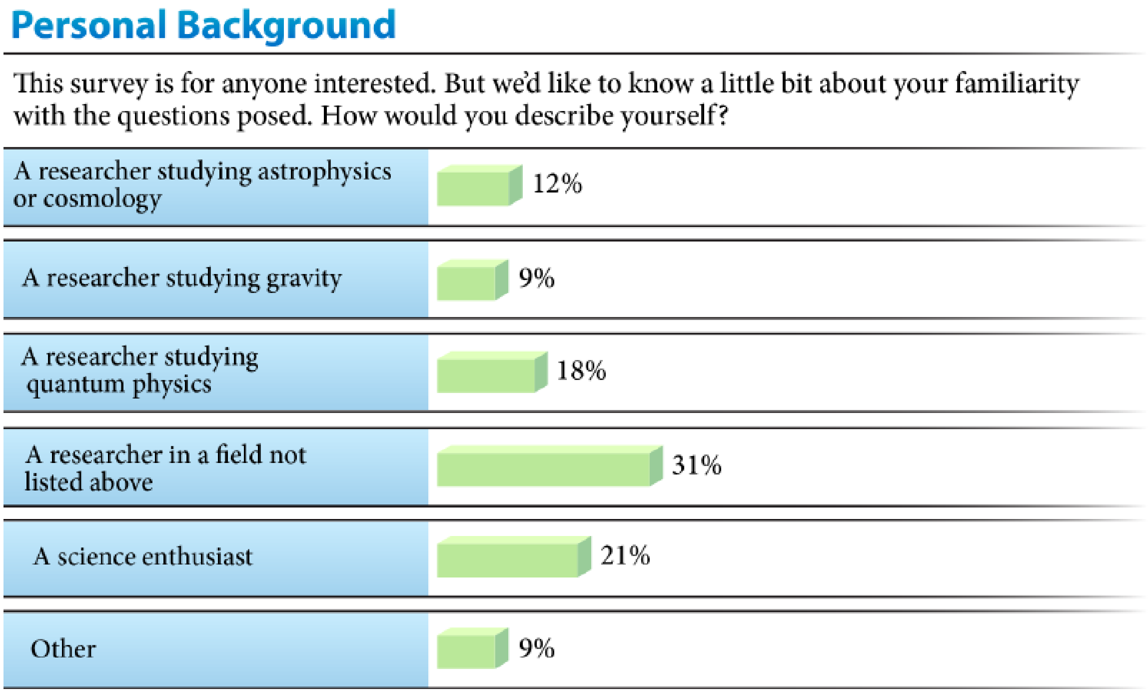


FIG. 1. Big Mysteries Survey (1,675 respondents): respondent background and self-reported profile information.

II. METHODS

The Big Mysteries Survey was posted by *Physics Magazine* from 28 July 2025 to 9 September 2025 [2]. The questionnaire covered topics in the foundations of quantum mechanics, cosmology, black-hole physics, quantum gravity, and anthropic coincidences. In total, 1,675 participants responded and were asked to indicate their status within the field.

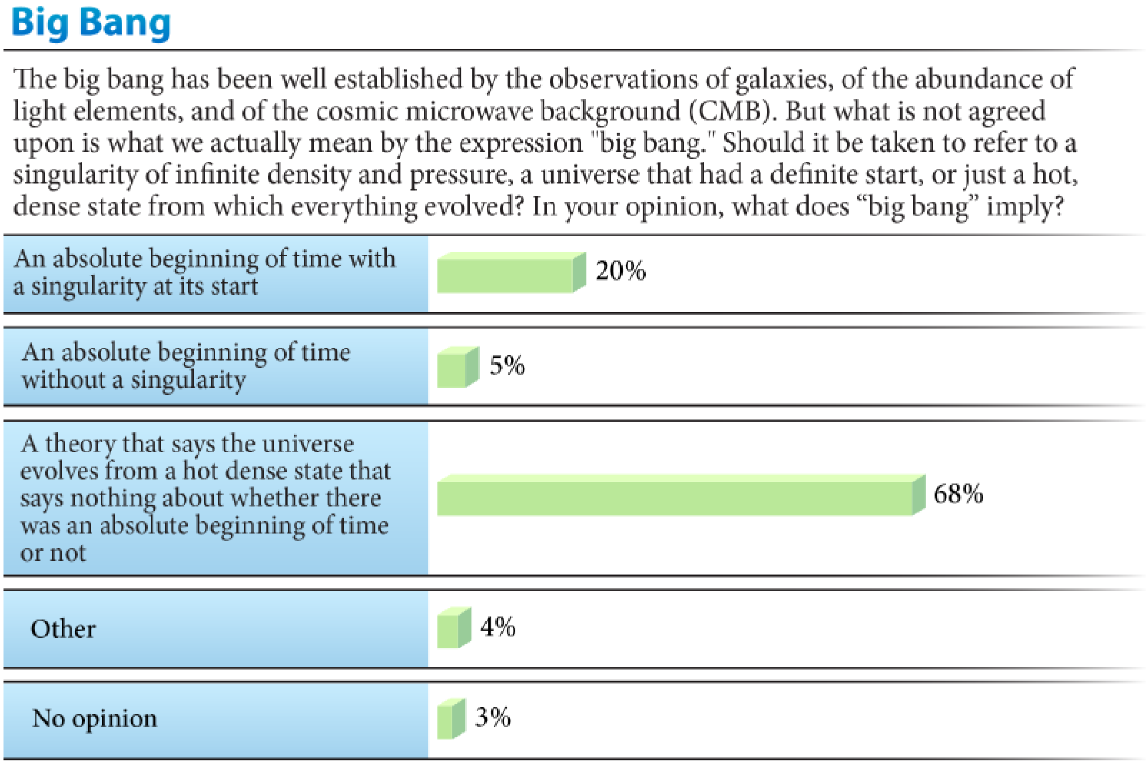
Because the Physics Magazine survey was an open online survey rather than a random sample of all physicists, the results should be interpreted as a large-scale snapshot of respondents' views rather than as a precise population estimate. Even with that caveat, the dataset is informative because of its size and topical breadth. In what follows, we present the response distributions and compare them, where relevant, with the earlier Copenhagen conference survey [1].

For qualitative context, we also analyzed the free-text "Other" responses in the survey spreadsheet. These responses are included in the anonymized dataset provided as supplemental material. They map in order to Questions 1–10. For each question, we reviewed all non-empty entries, grouped recurring themes by repeated concepts or phrasing, and included short verbatim quotations as illustrative examples in the corresponding Results subsection.

Finally, we study correlations among participant responses using a log-odds statistic. The methodology is detailed in Appendix A. In the cross-question analysis, we exclude the trivial pairings (“Other”, “Other”) and (“No opinion”, “No opinion”), which otherwise dominate the highest-frequency combinations.

III. RESULTS AND DISCUSSION

A. Q1: What Does the Big Bang Imply?



Big Bang

The big bang has been well established by the observations of galaxies, of the abundance of light elements, and of the cosmic microwave background (CMB). But what is not agreed upon is what we actually mean by the expression "big bang." Should it be taken to refer to a singularity of infinite density and pressure, a universe that had a definite start, or just a hot, dense state from which everything evolved? In your opinion, what does “big bang” imply?

FIG. 2. Big Mysteries Survey (1,675 respondents): What does the expression "the big bang" imply?

Multiple lines of evidence—including light-element abundances, the large-scale distribution of galaxies, and the existence and thermal properties of the cosmic microwave background (CMB)—support a Big Bang expansion history. What remains contested is what physicists mean by the phrase “the Big Bang.” Some leading cosmologists, most famously

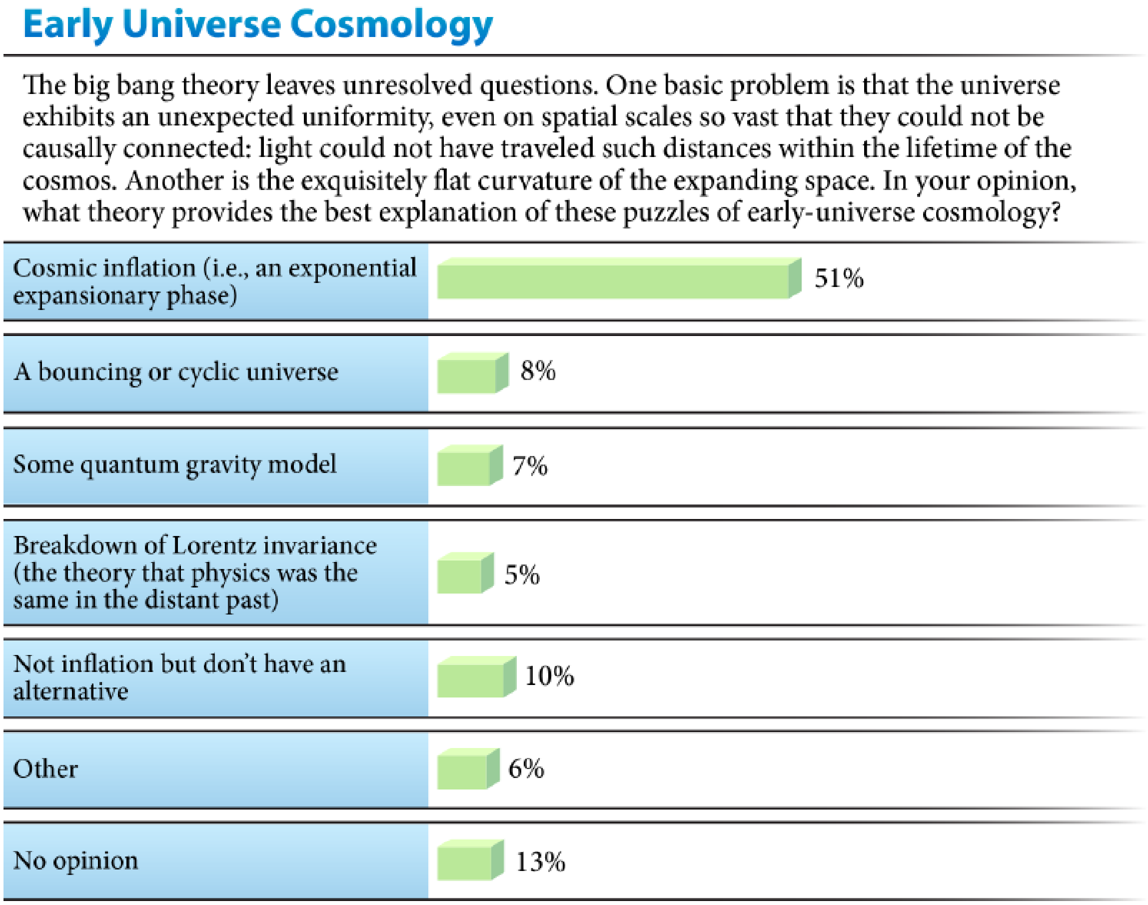
Stephen Hawking [3], have argued that a beginning of time is now effectively established. Others have challenged this interpretation [4], emphasizing that the Big Bang describes evolution from a hot, dense state and does not by itself settle the question of whether time had an absolute beginning.

The Big Mysteries Survey responses strongly favor the latter interpretation (Figure 2). Respondents overwhelmingly prefer to treat the Big Bang as a theory of cosmic evolution from a hot, dense state rather than as a statement that time began. In that sense, it may be more accurate to say that physicists regard the universe as *at least* 13.8 billion years old, rather than to infer that they thereby endorse a definite beginning of time.

Notably, this is the only question in the Big Mysteries Survey for which a single option receives a large majority (more than two-thirds). In the Physics Magazine sample, 68.4% endorse the “hot, dense state” interpretation, very close to the 68% reported in the Copenhagen survey. A significant difference between the two surveys, however, is the larger share of Physics Magazine respondents who interpret the Big Bang as implying a singularity and a beginning of time: 20% in the Physics Magazine survey versus 11% in the Copenhagen survey. This does not necessarily imply belief in a physically realized singularity; it may instead reflect a difference in how respondents interpret the phrase “Big Bang.”

The free-text “Other” responses for this question were dominated by framing disputes over language rather than by a single alternative theory. Representative comments include: “This is a terminology question. Different people use the term differently.” Several other comments similarly stressed that the meaning of “Big Bang” depends on context.

B. Q2: Early-Universe Puzzles and Inflation


Early Universe Cosmology

The big bang theory leaves unresolved questions. One basic problem is that the universe exhibits an unexpected uniformity, even on spatial scales so vast that they could not be causally connected: light could not have traveled such distances within the lifetime of the cosmos. Another is the exquisitely flat curvature of the expanding space. In your opinion, what theory provides the best explanation of these puzzles of early-universe cosmology?

FIG. 3. Big Mysteries Survey (1,675 respondents): Which theory best explains early-universe puzzles such as horizon and flatness?

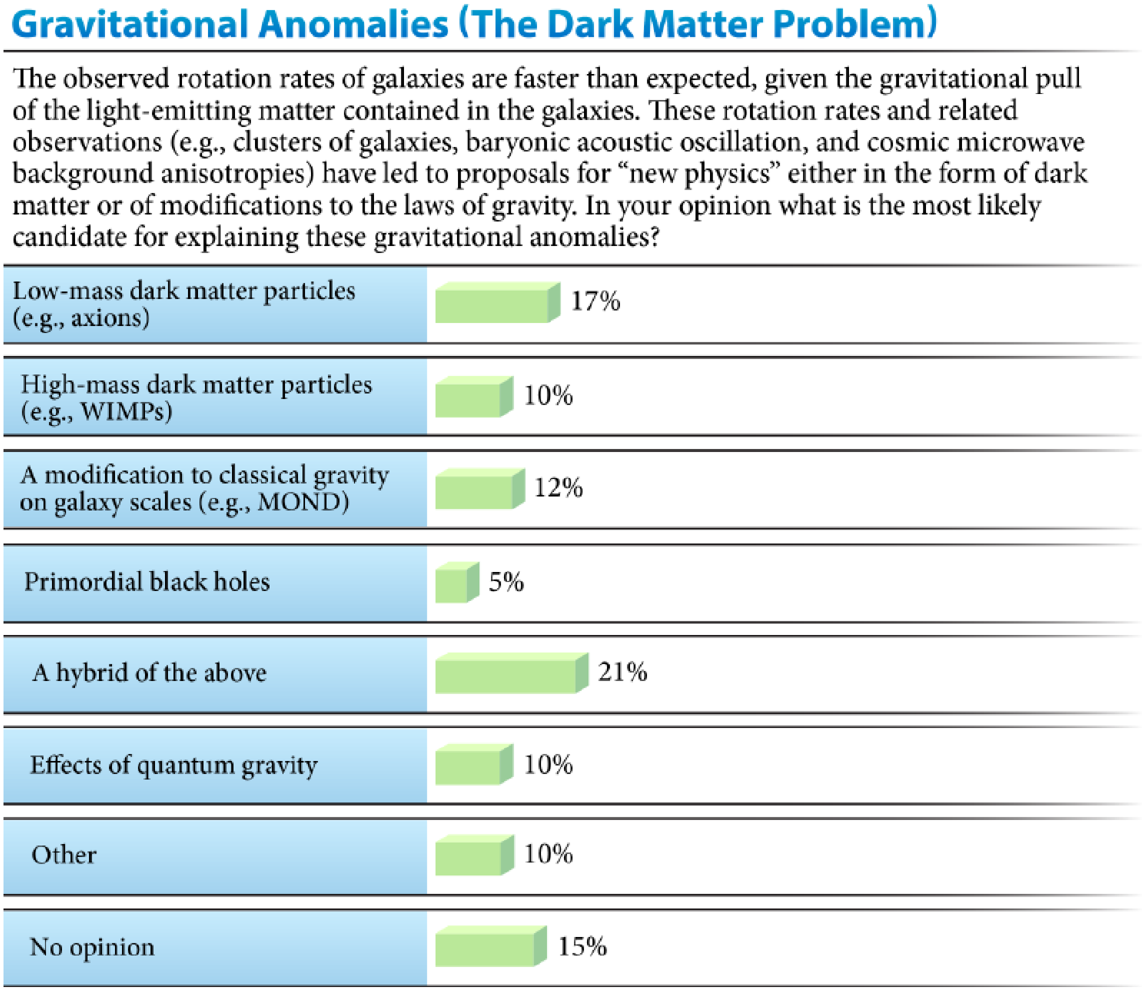
A second question addresses early-universe cosmology more directly by asking what respondents regard as the most likely solution to the horizon, structure, flatness, and monopole problems. Inflation is often presented as the standard answer to these puzzles [5], but it has also faced sustained criticism and competition from alternative proposals [6].

The Big Mysteries Survey responses show no overwhelming support for any single alternative, and inflation itself only narrowly exceeds the threshold for majority support (Figure 3). This raises the question of whether inflation should be described as a strong community consensus or, more cautiously, as the leading but contested option. Compared with the Copenhagen survey, the pattern is broadly similar, though inflation did not reach majority support there (44%), and “some quantum gravity model” was more popular (16% in

Copenhagen versus 7% in the Physics Magazine survey).

In the “Other” responses, the most common theme was hybrid early-universe scenarios that combine mechanisms, for example: “A combination of a bouncing/cyclic universe AND quantum effects during the bounce.” A smaller but recurrent theme questioned whether the standard formulation identifies a real paradox.

C. Q3: Dark Matter, Modified Gravity, and Gravitational Anomalies



The observed rotation rates of galaxies are faster than expected, given the gravitational pull of the light-emitting matter contained in the galaxies. These rotation rates and related observations (e.g., clusters of galaxies, baryonic acoustic oscillation, and cosmic microwave background anisotropies) have led to proposals for “new physics” either in the form of dark matter or of modifications to the laws of gravity. In your opinion what is the most likely candidate for explaining these gravitational anomalies?

Low-mass dark matter particles (e.g., axions)	17%
High-mass dark matter particles (e.g., WIMPs)	10%
A modification to classical gravity on galaxy scales (e.g., MOND)	12%
Primordial black holes	5%
A hybrid of the above	21%
Effects of quantum gravity	10%
Other	10%
No opinion	15%

FIG. 4. Big Mysteries Survey (1,675 respondents): Most likely explanation for gravitational anomalies usually attributed to dark matter.

Two survey questions address key components of the standard cosmological model, ΛCDM, in which the universe is dominated by a cosmological constant (Λ) and cold dark matter not accounted for by the Standard Model of particle physics [7]. The first asks about the most likely explanation of galactic rotation and related gravitational anomalies.

No single dark-matter candidate dominates the Big Mysteries Survey responses; instead, a hybrid answer is the most common choice (Figure 4). One plausible interpretation is that the non-detection of WIMPs in direct searches [8], together with the absence of supersymmetry signals at the LHC [9], has reduced confidence in WIMP-centered scenarios relative to other possibilities such as axions.

This overall pattern is consistent with the Copenhagen survey, where a hybrid model was also the leading response. A notable difference, however, is the stronger support in the Physics Magazine survey for modifying gravity (or invoking quantum-gravity effects) to explain phenomena often attributed to dark matter. In Copenhagen, modified gravity and quantum gravity together received only 5% support (1% MOND [10], 4% quantum gravity), whereas in the Physics Magazine survey the corresponding numbers rise to 11.5% (MOND) and 10.1% (quantum gravity). This increase appears to come partly at the expense of primordial black holes, which received 17% support in Copenhagen but only 5.4% in the Physics Magazine survey. Even so, when all dark-matter-candidate options are combined (hybrid models, axions, WIMPs, and primordial black holes), they exceed a majority, totaling 53.4%.

The "Other" free-text entries most often emphasized mixed or nonexclusive explanations. Typical comments include "I suspect that Dark Matter and Dark Energy have a common explanation" and "Normal matter that we have either missed or miscounted!" This pattern is consistent with the cross-question correlations below: respondents selecting modified-gravity or quantum-gravity explanations for dark-matter anomalies are also more likely to select related responses for cosmic acceleration and the Hubble tension (Table I).

D. Q4: Dark Energy and Cosmic Acceleration

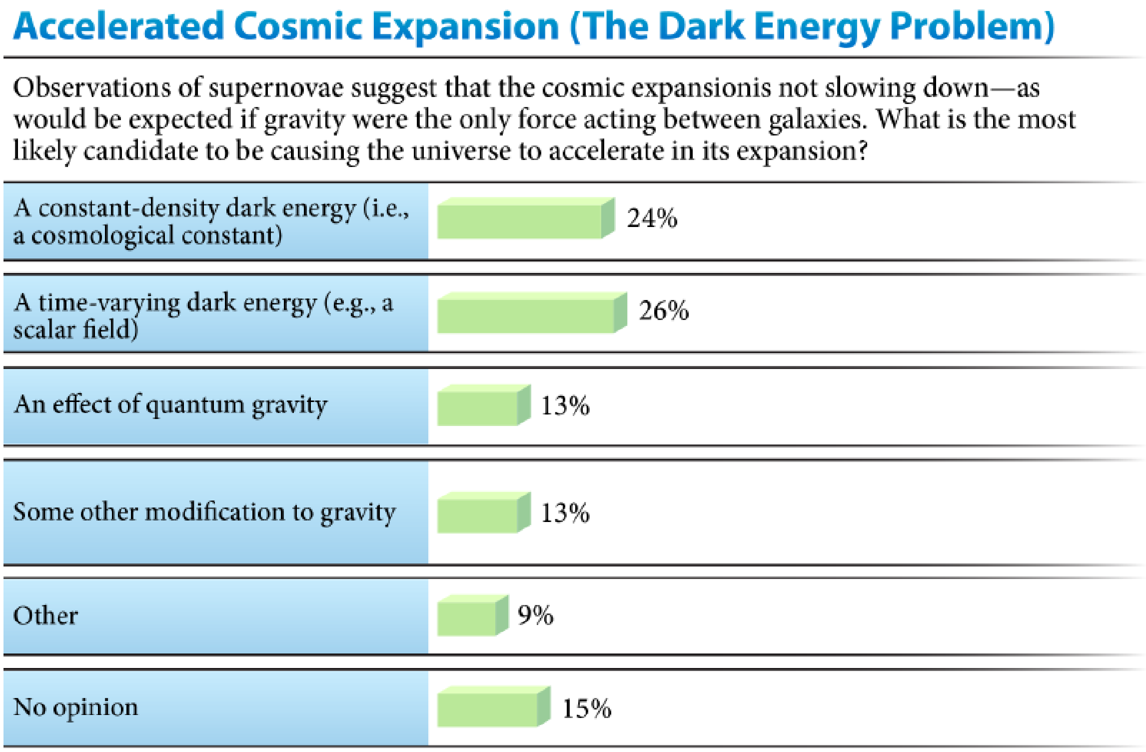


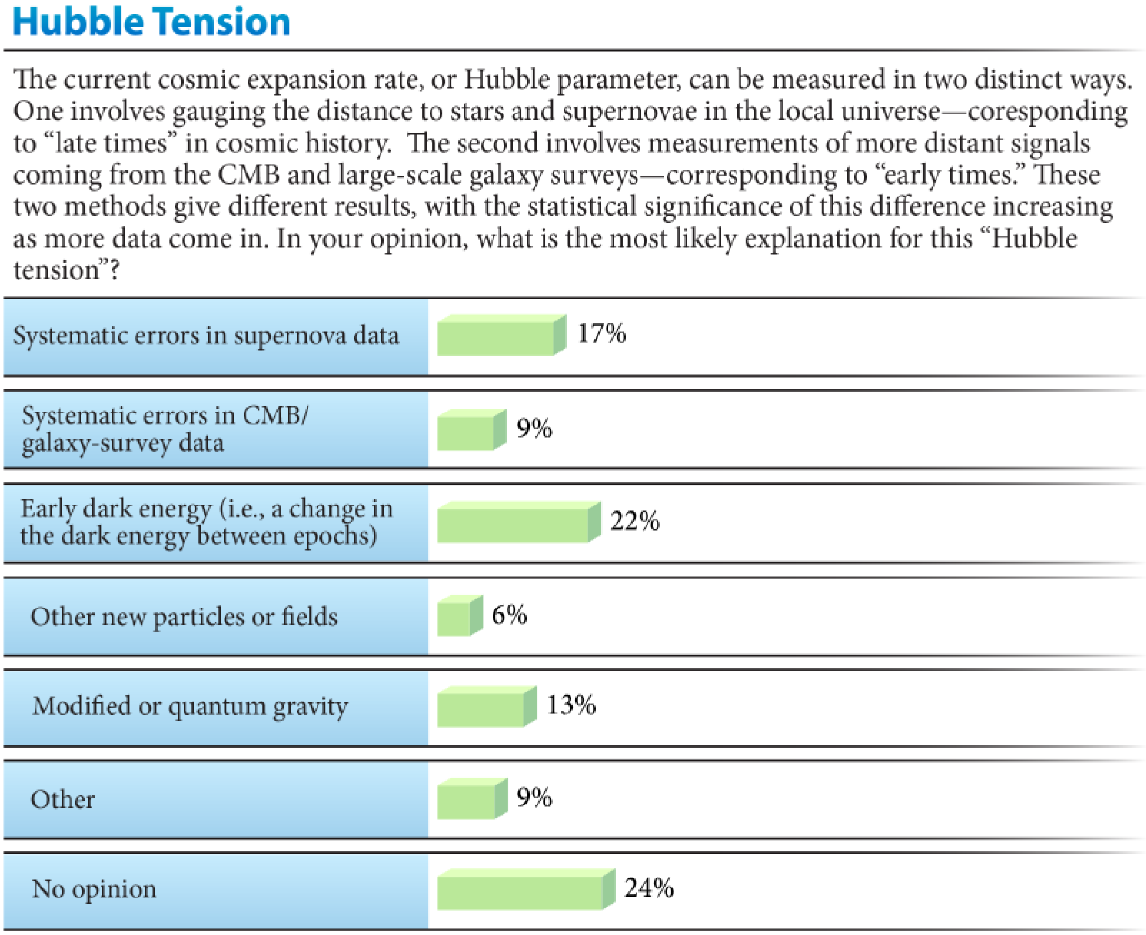
FIG. 5. Big Mysteries Survey (1,675 respondents): Most likely cause of the accelerated expansion of the universe.

The second ΛCDM-related question concerns dark energy. Here the Big Mysteries Survey responses are even less supportive of a canonical textbook answer than in the dark-matter question. A time-varying field is slightly more popular than a cosmological constant (25.9% versus 24.0%; Figure 5). One possible contributor to this shift is the influence of recent DESI-based analyses [11], which have been widely discussed in connection with evolving dark energy.

This represents a substantial change from the Copenhagen survey (conducted before the latest DESI release), where a cosmological constant was the most popular option (38%) and a time-varying field received only 16% support. Importantly, however, neither survey finds a majority for a cosmological constant. In that limited sense, many physicists do not appear to endorse the simplest textbook formulation of ΛCDM as strongly as public summaries sometimes imply.

The "Other" responses for this question were led by uncertainty and model incompleteness, with many respondents explicitly stating that key physics may still be missing. Examples include: “We’re missing some big piece of physics that I hope we’ll learn in my lifetime” and “With current evidence from DESI I do not feel confident selecting a constant or varying dark energy.” In the correlation analysis, this question shows some of the strongest cross-links in the survey: time-varying dark energy is tightly paired with early dark energy in the Hubble-tension question, and quantum-gravity answers here are tightly paired with quantum-gravity answers in both the dark-matter and Hubble-tension questions (Table I).

E. Q5: The Hubble Tension



Hubble Tension

The current cosmic expansion rate, or Hubble parameter, can be measured in two distinct ways. One involves gauging the distance to stars and supernovae in the local universe—coresponding to “late times” in cosmic history. The second involves measurements of more distant signals coming from the CMB and large-scale galaxy surveys—corresponding to “early times.” These two methods give different results, with the statistical significance of this difference increasing as more data come in. In your opinion, what is the most likely explanation for this “Hubble tension”?

FIG. 6. Big Mysteries Survey (1,675 respondents): Most likely explanation for the Hubble tension.

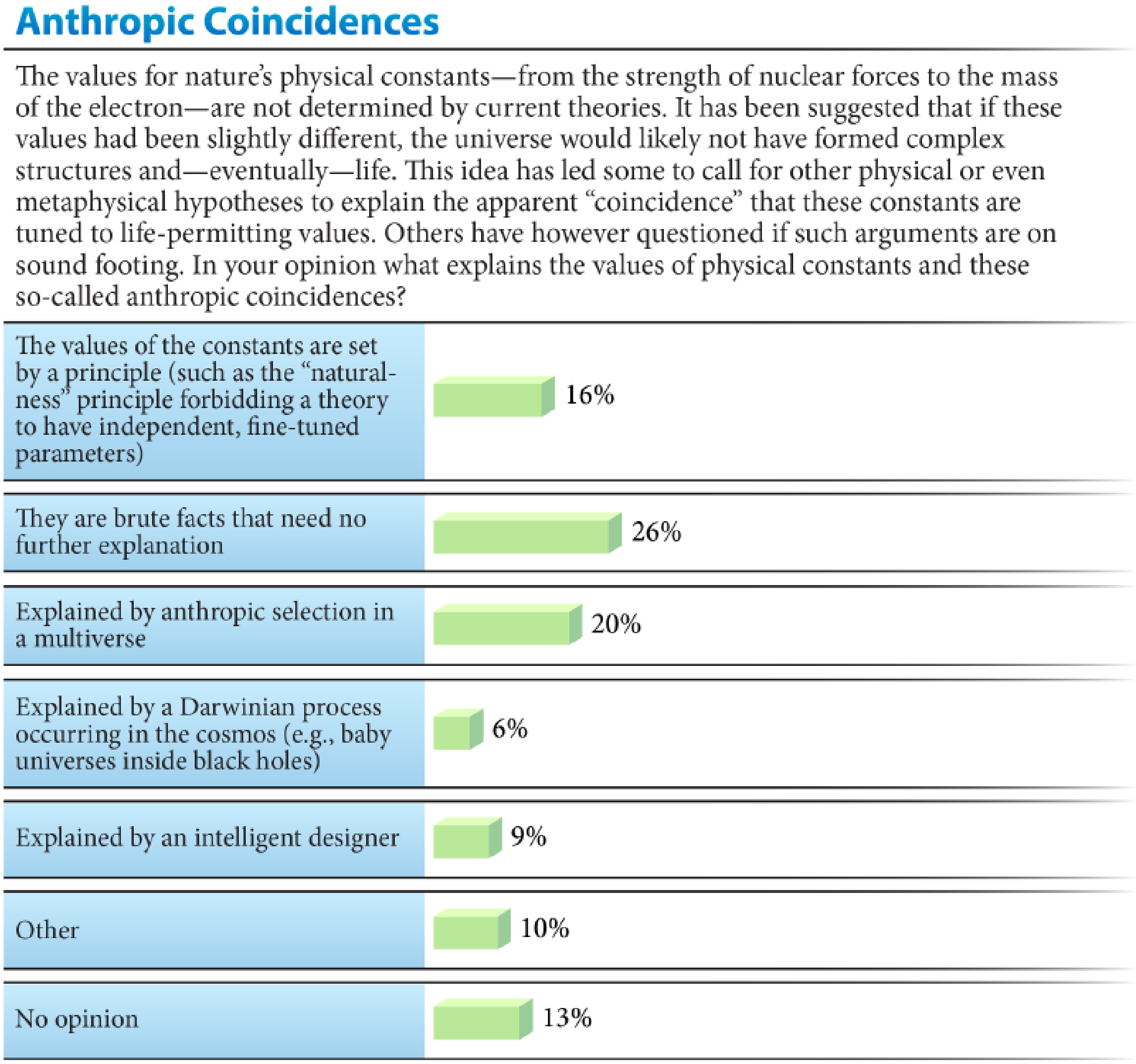
Another challenge to the standard cosmological picture is the Hubble tension, in which two established methods of measuring the cosmic expansion rate yield inconsistent values

[12–14]. Responses to this question indicate less confidence than in many of the other topics surveyed. “No opinion” is the most common response (24.4%), followed by early dark energy (22.1%) (Figure 6).

This differs sharply from the Copenhagen survey, where systematic errors in supernova data were the most popular explanation (35%), compared with only 16.7% in the Physics Magazine survey. The contrast may reflect differences in respondent composition, changes in the literature between the two surveys, or both.

The dominant “Other” theme here was not a single new mechanism but combined-systematics accounts, e.g., “Both Systematic errors in CMB/galaxy-survey data And Systematic errors in supernova data.” A second recurring theme was dissatisfaction with baseline modeling, such as “Problems with LCDM model used to model early universe.” Consistent with this, correlated-response analysis indicates that many respondents who endorse early dark energy for the Hubble tension also endorse time-varying dark energy for cosmic acceleration, while those choosing modified/quantum-gravity explanations for the Hubble tension are strongly linked to analogous choices in the dark-matter and dark-energy questions (Table I).

F. Q6: Anthropic Coincidences and Physical Constants



The values for nature's physical constants—from the strength of nuclear forces to the mass of the electron—are not determined by current theories. It has been suggested that if these values had been slightly different, the universe would likely not have formed complex structures and—eventually—life. This idea has led some to call for other physical or even metaphysical hypotheses to explain the apparent "coincidence" that these constants are tuned to life-permitting values. Others have however questioned if such arguments are on sound footing. In your opinion what explains the values of physical constants and these so-called anthropic coincidences?

The values of the constants are set by a principle (such as the "naturalness" principle forbidding a theory to have independent, fine-tuned parameters)	16%
They are brute facts that need no further explanation	26%
Explained by anthropic selection in a multiverse	20%
Explained by a Darwinian process occurring in the cosmos (e.g., baby universes inside black holes)	6%
Explained by an intelligent designer	9%
Other	10%
No opinion	13%

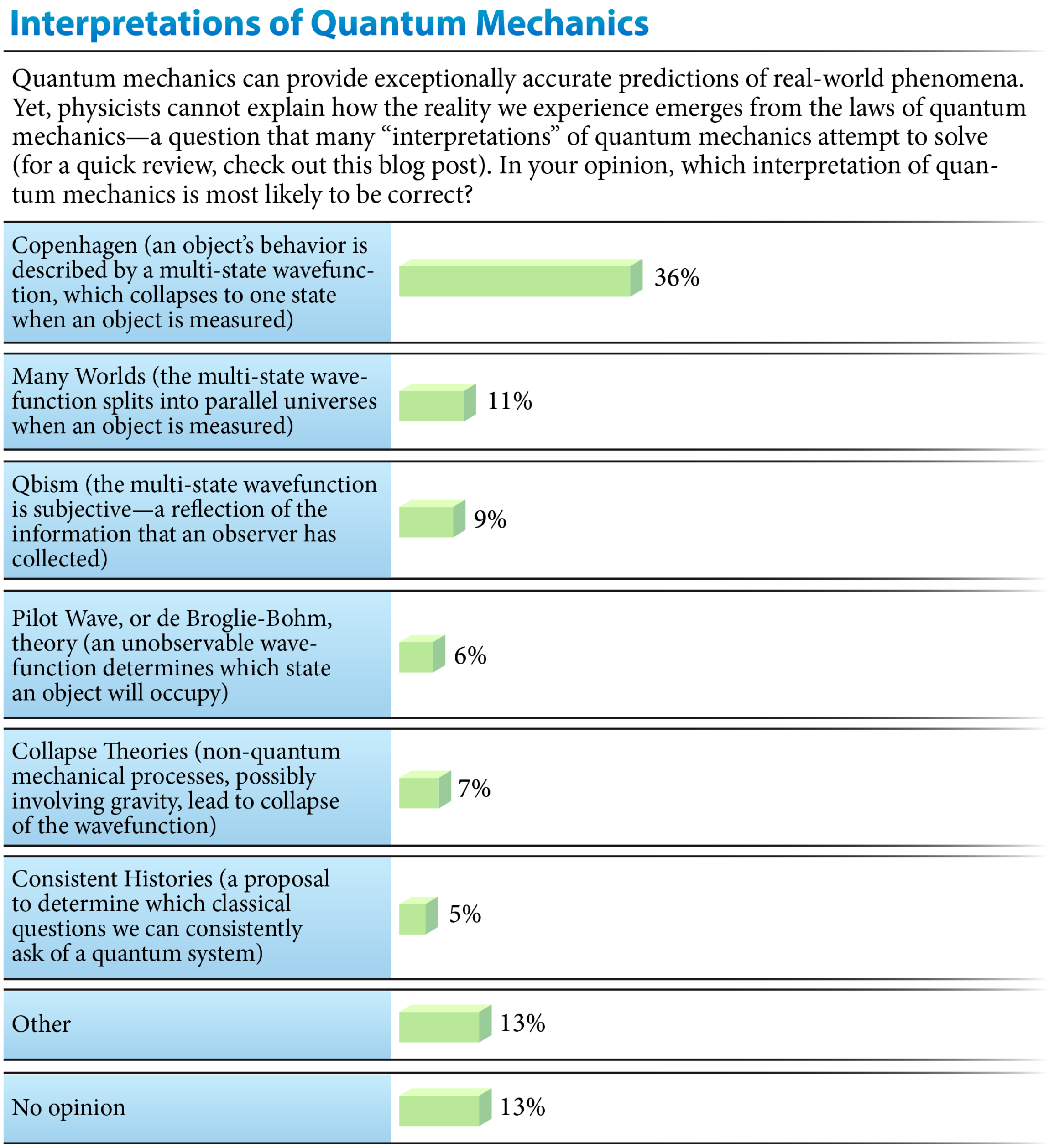
FIG. 7. Big Mysteries Survey (1,675 respondents): What explains anthropic coincidences and the observed values of physical constants?

It is often argued that small changes in the fundamental constants of nature would prevent the emergence of complex structure or life [15]. If so, what explains the observed life-permitting values? Popular discussions frequently frame the issue as forcing a choice between intelligent design and multiverse-based anthropic selection [16].

The Big Mysteries Survey results do not support that framing (Figure 7). The most common response is that the constants are brute facts requiring no further explanation (26%). This was also the most common response in the Copenhagen survey (33%) [1] and in the PhilPapers survey of philosophers (32%) [17]. Moreover, even when the multiverse and intelligent-design responses are combined, they still fall short of a majority (28.8%). These results suggest that many physicists do not accept the premise that fine-tuning arguments compel commitment to either of those two explanatory frameworks.

The "Other" comments most commonly challenged narrow fine-tuning framing and anthropocentric assumptions. Illustrative responses include: "the anthropic principle means little" and "To think otherwise is unforgivably anthropocentric." Another recurring theme asked for deeper fundamental explanation rather than either design or multiverse commitment.

G. Q7: Interpretations of Quantum Mechanics



Interpretations of Quantum Mechanics

Quantum mechanics can provide exceptionally accurate predictions of real-world phenomena. Yet, physicists cannot explain how the reality we experience emerges from the laws of quantum mechanics—a question that many "interpretations" of quantum mechanics attempt to solve (for a quick review, check out this blog post). In your opinion, which interpretation of quantum mechanics is most likely to be correct?

Copenhagen (an object's behavior is described by a multi-state wavefunction, which collapses to one state when an object is measured)	36%
Many Worlds (the multi-state wavefunction splits into parallel universes when an object is measured)	11%
Qbism (the multi-state wavefunction is subjective—a reflection of the information that an observer has collected)	9%
Pilot Wave, or de Broglie-Bohm, theory (an unobservable wavefunction determines which state an object will occupy)	6%
Collapse Theories (non-quantum mechanical processes, possibly involving gravity, lead to collapse of the wavefunction)	7%
Consistent Histories (a proposal to determine which classical questions we can consistently ask of a quantum system)	5%
Other	13%
No opinion	13%

FIG. 8. Big Mysteries Survey (1,675 respondents): Which interpretation of quantum mechanics is most likely correct?

Turning to quantum foundations, interpretations of quantum mechanics have been the subject of several recent surveys. A widely discussed *Nature* survey [18], for example, found the Copenhagen interpretation to be the most favored option (36%). The Physics Magazine survey yields a very similar top-line result, with Copenhagen favored by 35.7% of respondents

(Figure 8).

The ranking of alternatives differs, however. In the Physics Magazine survey, Many-Worlds is the second most selected named interpretation (11%), whereas the *Nature* survey reported epistemic interpretations (such as Qbism) as the second most popular category (17%). It is also notable that, in the Physics Magazine sample, both “no opinion” and “other” outpoll Many-Worlds. This underscores the extent of continuing fragmentation in views on the interpretation of quantum mechanics. For canonical formulations or modern introductions to several of the named options, see [19–23].

In the “Other” free-text entries, the most common named alternatives included relational quantum mechanics. A second recurring theme was dissatisfaction with the provided taxonomy, captured by comments like “None of the above.” At the cross-question level, one notable high-log-odds pair links “anthropic selection in a multiverse” with “Many Worlds,” suggesting that respondents attracted to explicitly multiverse-based reasoning in cosmology are also more likely to select a multiverse-like quantum interpretation (Table I).

H. Q8: Black Hole Event Horizons and the Fate of Infalling Matter

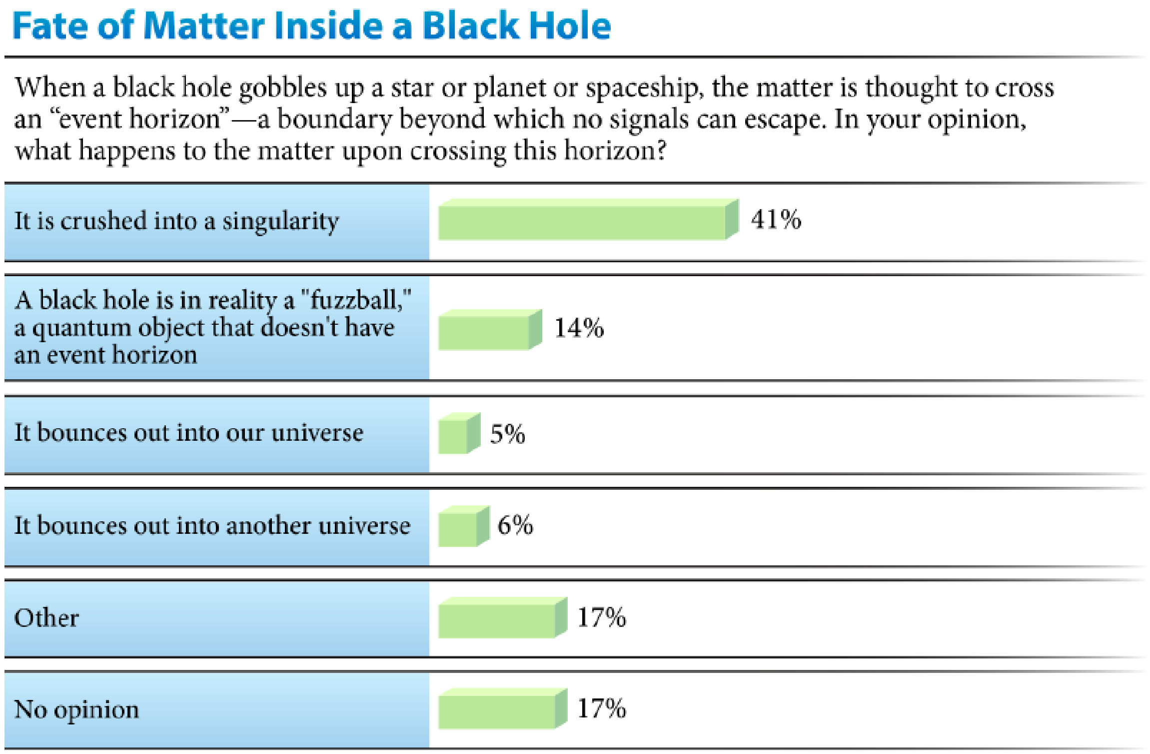


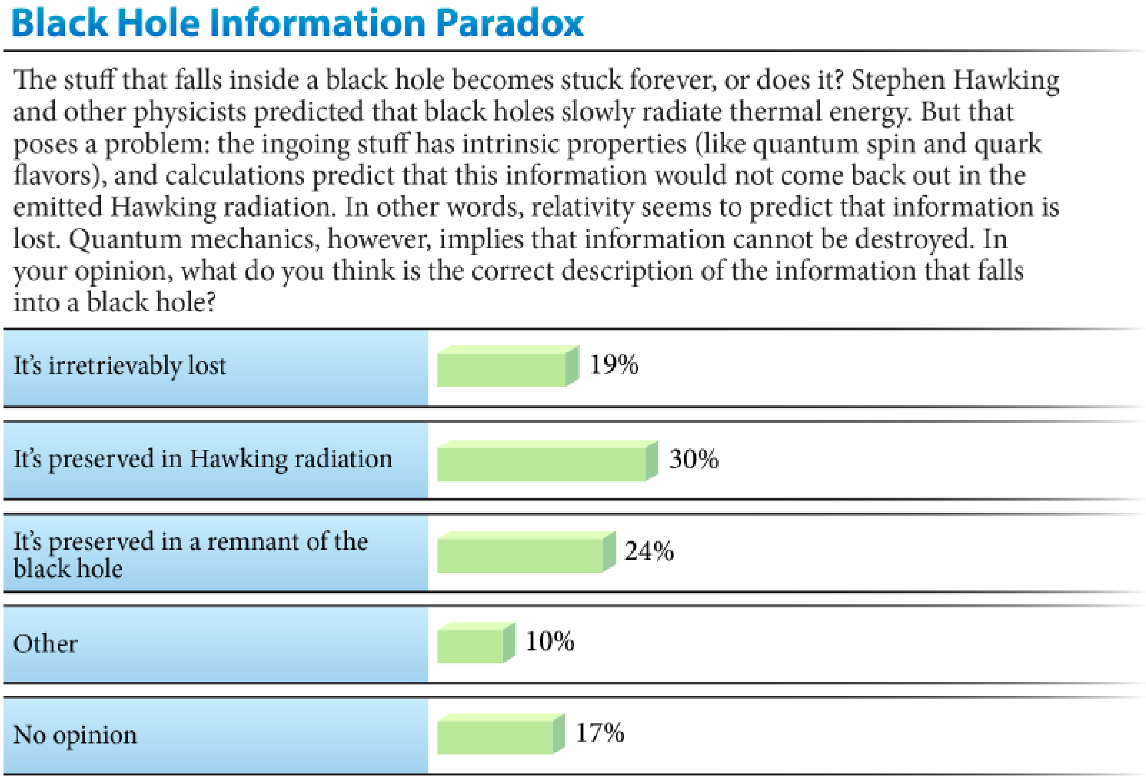
FIG. 9. Big Mysteries Survey (1,675 respondents): What happens to matter after crossing a black hole event horizon?

Another topic on which a textbook-style answer fails to command a majority concerns the fate of matter crossing a black hole event horizon. In standard general-relativistic language, infalling matter is often said to end in a singularity [24]. This is the most popular Big Mysteries Survey response (40.5%), but it still falls well short of a majority (Figure 9).

This option is substantially more popular in the Physics Magazine survey than in the Copenhagen survey (29%). Conversely, alternatives such as matter bouncing into our universe or another universe receive less support in the Physics Magazine survey than in the Copenhagen sample.

Among "Other" responses, the most common theme was that horizon crossing is locally uneventful: "Nothing happens ... it simply continues to free-fall forever." Closely related comments emphasized that crossing does not immediately imply singular behavior: "nothing special is guaranteed to happen."

I. Q9: Black Hole Information



Black Hole Information Paradox

The stuff that falls inside a black hole becomes stuck forever, or does it? Stephen Hawking and other physicists predicted that black holes slowly radiate thermal energy. But that poses a problem: the ingoing stuff has intrinsic properties (like quantum spin and quark flavors), and calculations predict that this information would not come back out in the emitted Hawking radiation. In other words, relativity seems to predict that information is lost. Quantum mechanics, however, implies that information cannot be destroyed. In your opinion, what do you think is the correct description of the information that falls into a black hole?

FIG. 10. Big Mysteries Survey (1,675 respondents): Which description of black hole information is most likely correct?

Black holes also lie at the center of the information paradox. A common way of stating the tension is that semiclassical gravity appears to permit information loss, whereas quantum theory strongly motivates information preservation [25]. It is sometimes claimed that physicists now broadly agree that information is preserved, with disagreement only about the mechanism [26]. The Big Mysteries Survey results suggest that this consensus narrative is overstated.

Information preservation only narrowly exceeds a majority in the Physics Magazine survey. Combining preservation via Hawking radiation (30.5%) and via black hole remnants (23.7%) yields 54.2% (Figure 10). Information loss remains a minority view, but at 18.8% it is far from negligible. These results closely track the Copenhagen survey, which also found 53% support for information preservation (27% Hawking radiation, 26% remnants) and 18.8% support for information loss.

In "Other" free-text comments, recurrent alternatives invoked near-horizon structure and holography, for example: "A black hole has hair" and "Holographic event horizon." The correlation analysis adds one clear cross-domain association: respondents who choose information preservation in Hawking radiation are significantly more likely to select String Theory/M-Theory as their preferred quantum-gravity framework (Table I).

J. Q10: Candidates for Quantum Gravity

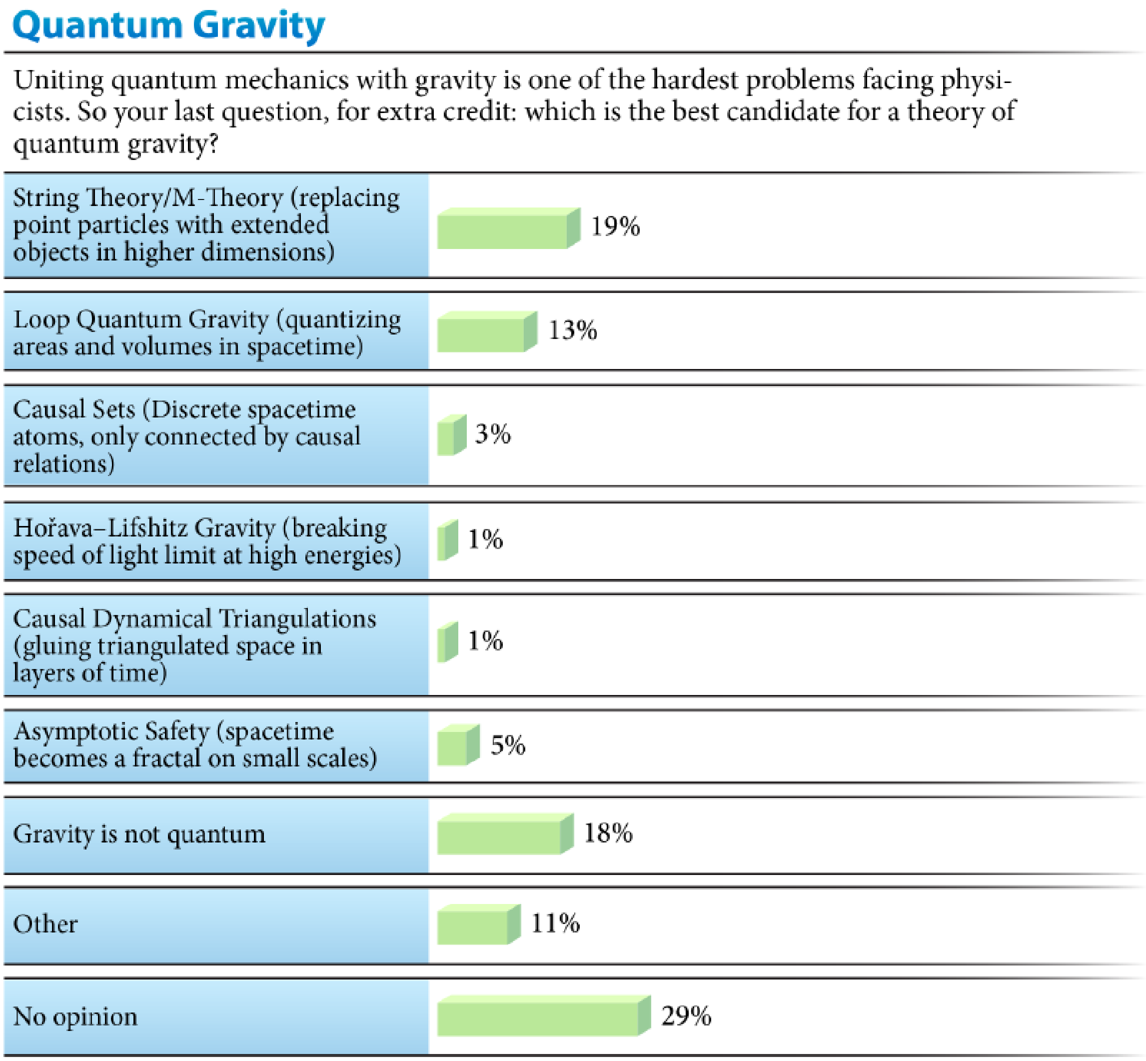


FIG. 11. Big Mysteries Survey (1,675 respondents): Which candidate is most likely to provide a theory of quantum gravity?

Perhaps the most prominent unresolved problem in fundamental physics is the reconciliation of quantum mechanics with general relativity. The Big Mysteries Survey responses show no dominant approach, and uncertainty is visible in the fact that "no opinion" is the most selected response (Figure 11). String theory remains the most popular named proposal, but with only 18.9% support.

Notably, the view that gravity is not quantum ranks third (17.7%), ahead of loop quantum gravity (12.7%). If one combines the listed non-string quantum-gravity approaches, they account for 23.1% of responses, suggesting that even if string theory remains the best-known candidate, many physicists do not treat it as uniquely compelling. The overall pattern is similar to the Copenhagen survey, where string theory received 21% support and non-string alternatives combined received 19%.

The "Other" responses most commonly expressed dissatisfaction with the current menu of options, often simply "none of the above." A related theme argued that the correct framework is still missing, e.g., "the mathematical formula ... has not yet been developed."

K. Correlated Response Patterns Across Questions

Using the log-odds statistic defined in Appendix A, we identify highly correlated response pairs by $\log \mathcal{O} > 25$ (roughly $+7\sigma$) and strongly anticorrelated pairs by $\log \mathcal{O} < -15$ (roughly -5σ). The strongest positive associations cluster around internally consistent theory bundles: quantum-gravity explanations across early-universe, dark-matter, and dark-energy questions; modified-gravity pairings across dark-matter and dark-energy anomalies; and the dark-energy/Hubble-tension linkage between time-varying dark energy and early dark energy. A separate high-correlation cluster links black-hole information preservation in Hawking radiation with string-theory preference for quantum gravity. Figure 12 visualizes this split directly: the right tail beyond the $+7\sigma$ line feeds Table I, while the left tail beyond the -5σ line feeds Table II.

The negative-tail pairs mostly involve "Other" or "No opinion" responses, indicating that respondents who select specific mainstream answers in one domain are statistically less likely than chance to select broad residual categories in related domains.

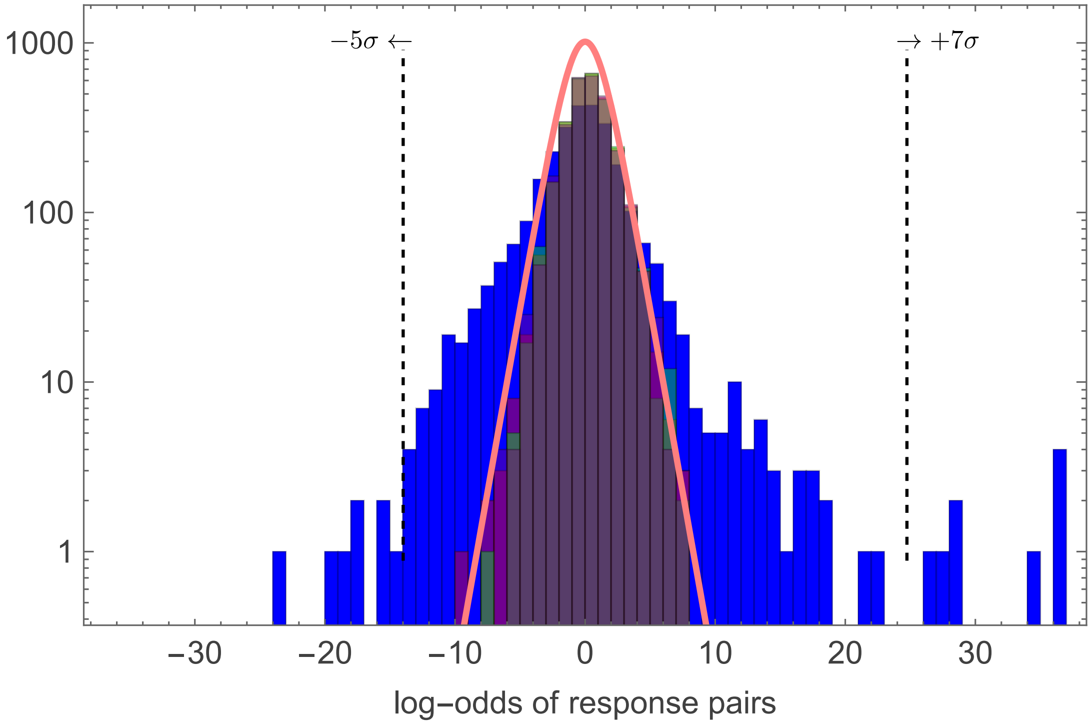


FIG. 12. Distribution of log-odds values (blue histogram) for pairwise response correlations. Positive values indicate co-selection above chance expectation; negative values indicate co-selection below chance. The pink/red/purple histograms show three random realizations, assuming uncorrelated pairs, while the pink curve shows the theoretical prediction in Equation (A4). The overlaid dashed vertical lines mark the thresholds used in this paper: $\log \mathcal{O} < -15$ (approximately -5σ) for strongly anticorrelated pairs and $\log \mathcal{O} > 25$ (approximately $+7\sigma$) for strongly correlated pairs.

IV. CONCLUSION

In summary, the Big Mysteries Survey suggests that physicists are more divided on many foundational questions than popular accounts often imply. Several positions frequently presented as settled or near-consensus views do not command majority support in this dataset. The clearest exception is the interpretation of what the phrase “Big Bang” implies, for which more than two-thirds of respondents prefer the “hot, dense state” reading over an explicit beginning-of-time interpretation.

Across cosmology, the results indicate limited support for treating the simplest textbook version of ΛCDM as an uncontroversial consensus package, and they do not support the claim that fine-tuning arguments force a choice between intelligent design and multiverse anthropic

TABLE I. Most positively correlated response pairs ($\log \mathcal{O} > 25$).

Pair of responses	N_{both}	Log-odds
Q2: Some quantum gravity model ↔ Q3: Effects of quantum gravity	43	28.7
Q2: Some quantum gravity model ↔ Q5: Modified or quantum gravity	49	26.7
Q3: MOND/modification to gravity ↔ Q4: Some other modification to gravity	85	36.0
Q3: Effects of quantum gravity ↔ Q4: An effect of quantum gravity	96	36.0
Q3: Effects of quantum gravity ↔ Q5: Modified or quantum gravity	69	34.7
Q4: Time-varying dark energy ↔ Q5: Early dark energy	219	36.0
Q4: An effect of quantum gravity ↔ Q5: Modified or quantum gravity	88	36.0
Q6: Anthropic selection in a multiverse ↔ Q7: Many Worlds	87	28.9
Q9: Information preserved in Hawking radiation ↔ Q10: String Theory/M-Theory	172	28.0

selection. Inflation and black-hole information preservation receive majority support, but only narrowly. In quantum foundations and quantum gravity, the best-known proposals remain leading candidates, yet none secures majority endorsement. More broadly, the survey highlights the importance of distinguishing between "most popular" and "consensus" when describing contemporary physics to wider audiences. The correlated-response analysis reinforces this picture by revealing structured sub-communities of views rather than a single dominant paradigm. The strongest positive pairs mostly connect conceptually aligned answers across questions (for example, modified-gravity with modified-gravity, quantum-gravity with quantum-gravity, and time-varying dark energy with early dark energy), while the strongest negative pairs are concentrated in "Other"/"No opinion" residual categories. These correlations should be interpreted as patterns of coherence in respondent worldviews, not as causal relationships between the underlying physical hypotheses.

As seen in Figure 12, the response patterns show substantially richer correlation structure,

TABLE II. Most anticorrelated response pairs ($\log \mathcal{O} < -15$).

Pair of responses	N_{both}	Log-odds
Personal background: Researcher studying gravity ↔ Q10: No opinion	12	-18.0
Q3: No opinion ↔ Q5: Early dark energy	21	-16.0
Q3: Other ↔ Q8: Crushed into a singularity	24	-19.7
Q4: Other ↔ Q8: Crushed into a singularity	26	-15.5
Q7: Other ↔ Q8: Crushed into a singularity	42	-17.0
Q8: Crushed into a singularity ↔ Q9: Other	23	-23.1
Q8: Crushed into a singularity ↔ Q10: Other	34	-17.3

and likely higher-order organization, than we have analyzed in this study. We therefore provide the anonymized raw data as supplemental material, so that other researchers can further investigate this dataset, which offers a rare window into how scientists think about major unresolved questions in fundamental physics.

ACKNOWLEDGMENTS

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Appendix A: Statistical Measure of Correlation

In this appendix, we outline the statistical approach we use to study correlations amongst responses. Imagine the number of participants who choose the Response R_1 to the Question Q_1 is $n(R_1|Q_1)$. Similarly, the number of responses R_2 to Question Q_2 is $n(R_2|Q_2)$. Meanwhile, the number of people who respond R_1 to Q_1 *and* R_2 to Q_2 is $n(R_1, R_2|Q_1, Q_2)$. If there were no correlations amongst the responses, one would expect:

$$n_{\text{uncorr.}}(R_1, R_2|Q_1, Q_2) = \frac{n(R_1|Q_1) \times n(R_2|Q_2)}{N}. \tag{A1}$$

We can now define the log-odds statistics as:

$$\log \mathcal{O}(R_1, R_2|Q_1, Q_2) \equiv \ln \left\{ \frac{P\left[n(R_1, R_2|Q_1, Q_2) \leq n_{\text{uncorr.}}(R_1, R_2|Q_1, Q_2)\right]}{P\left[n(R_1, R_2|Q_1, Q_2) > n_{\text{uncorr.}}(R_1, R_2|Q_1, Q_2)\right]} \right\}, \tag{A2}$$

where P is defined using cumulative Poisson probability distribution

$$P[n \leq \bar{n}] = 1 - P[n > \bar{n}] \equiv \frac{\Gamma(1+n, \bar{n})}{\Gamma(1+n)}. \tag{A3}$$

If $n(R_1, R_2|Q_1, Q_2)$ comes from a random Poisson sampling of $n_{\text{uncorr.}}(R_1, R_2|Q_1, Q_2)$, then it is easy to see that $\log \mathcal{O}$ should follow a probability distribution, centred around zero, given by:

$$\frac{dP}{d \log \mathcal{O}} = \frac{1}{4} \text{sech}^2 \left(\frac{\log \mathcal{O}}{2} \right). \tag{A4}$$

Large positive (negative) values of log-odds that significantly deviate from this distribution suggest statistical correlation (anti-correlation) amongst responses by the participants. For examples, values of $|\log \mathcal{O}| > 15$ (27) would correspond to 5σ (7σ) anomalies from uncorrelated random distribution.

Appendix B: Full Survey Question Tables

This appendix reproduces the full question wording and full answer choices shown in the original survey table images, along with the reported counts and percentages. Uncertainties are reported as Poisson 1σ errors, with $\sigma_n = \sqrt{n}$ for counts and propagated percentage errors $\sigma_f = 100\sqrt{n}/1675$.

1. Question 1: Big Bang Meaning

Question. The big bang has been well established by the observations of galaxies, of the abundance of light elements, and of the cosmic microwave background (CMB). But what is not agreed upon is what we actually mean by the phrase big bang. Should it be taken to refer to a singularity of infinite density and pressure, a universe that had a definite start, or just a hot, dense state from which everything evolved? In your opinion, what does the expression "the big bang" imply?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
An absolute beginning of time with a singularity at its start	325 ± 18.0	19.5 ± 1.1
An absolute beginning of time without a singularity	75 ± 8.7	4.5 ± 0.5
A theory that says the universe evolves from a hot dense state that says nothing about whether there was an absolute beginning of time or not	1141 ± 33.8	68.4 ± 2.0
Other	69 ± 8.3	4.1 ± 0.5
No opinion	57 ± 7.5	3.4 ± 0.5

2. Question 2: Early-Universe Puzzles

Question. The big bang theory leaves unresolved questions. One basic problem is that the universe exhibits an unexpected uniformity, even on spatial scales so vast that they could not be causally connected: light could not have traveled such distances within the lifetime of the cosmos. Another is the exquisitely flat curvature of the expanding space. In your opinion, what theory provides the best explanation of these puzzles of early-universe cosmology?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
Cosmic inflation (i.e., an exponential expansionary phase)	847 ± 29.1	50.8 ± 1.7
A bouncing or cyclic universe	129 ± 11.4	7.7 ± 0.7
Some quantum gravity model	116 ± 10.8	7.0 ± 0.6

Answer	Count (±1σ)	Percent (±1σ)
Breakdown of Lorentz invariance (the theory that physics was the same in the distant past)	87 ± 9.3	5.2 ± 0.6
Not inflation but don't have an alternative	169 ± 13.0	10.1 ± 0.8
Other	94 ± 9.7	5.6 ± 0.6
No opinion	226 ± 15.0	13.5 ± 0.9

3. Question 3: Dark Matter or Modified Gravity

Question. The observed rotation rates of galaxies are faster than expected, given the gravitational pull of the light-emitting matter contained in the galaxies. These rotation rates and related observations (e.g., clusters of galaxies, baryonic acoustic oscillation, and cosmic microwave background anisotropies) have led to proposals for "new physics" either in the form of dark matter or of modifications to the laws of gravity. In your opinion what is the most likely candidate for explaining these gravitational anomalies?

Answer	Count (±1σ)	Percent (±1σ)
Low-mass dark matter particles (e.g., axions)	290 ± 17.0	17.4 ± 1.0
High-mass dark matter particles (e.g., WIMPs)	167 ± 12.9	10.0 ± 0.8
A modification to classical gravity on galaxy scales (e.g., MOND)	192 ± 13.9	11.5 ± 0.8
Primordial black holes	90 ± 9.5	5.4 ± 0.6
A hybrid of the above	344 ± 18.5	20.6 ± 1.1
Effects of quantum gravity	168 ± 13.0	10.1 ± 0.8
Other	164 ± 12.8	9.8 ± 0.8
No opinion	252 ± 15.9	15.1 ± 0.9

4. Question 4: Cause of Cosmic Acceleration

Question. Observations of supernovae suggest that the cosmic expansion is not slowing down—as would be expected if gravity were the only force acting between galaxies. What is the most likely candidate to be causing the universe to accelerate in its expansion?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
A constant-density dark energy (i.e., a cosmological constant)	400 ± 20.0	24.0 ± 1.2
A time-varying dark energy (e.g., a scalar field)	431 ± 20.8	25.9 ± 1.2
An effect of quantum gravity	214 ± 14.6	12.9 ± 0.9
Some other modification to gravity	216 ± 14.7	13.0 ± 0.9
Other	155 ± 12.4	9.3 ± 0.7
No opinion	249 ± 15.8	15.0 ± 0.9

5. Question 5: Hubble Tension

Question. The current cosmic expansion rate, or Hubble parameter, can be measured in two distinct ways. One involves gauging the distance to stars and supernovae in the local universe—corresponding to "late times" in cosmic history. The second involves measurements of more distant signals coming from the CMB and large-scale galaxy surveys—corresponding to "early times." These two methods give different results, with the statistical significance of this difference increasing as more data come in. In your opinion, what is the most likely explanation for this "Hubble tension"?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
Systematic errors in supernova data	277 ± 16.6	16.7 ± 1.0
Systematic errors in CMB/galaxy-survey data	146 ± 12.1	8.8 ± 0.7
Early dark energy (i.e., a change in the dark energy between epochs)	368 ± 19.2	22.1 ± 1.1
Other new particles or fields	92 ± 9.6	5.5 ± 0.6
Modified or quantum gravity	223 ± 14.9	13.4 ± 0.9
Other	150 ± 12.2	9.0 ± 0.7
No Opinion	406 ± 20.1	24.4 ± 1.2

6. Question 6: Anthropic Coincidences

Question. The values for nature's physical constants—from the strength of nuclear forces to the mass of the electron—are not determined by current theories, It has been suggested that if these values had been slightly different, the universe would likely not have formed complex structures and—eventually—life. This idea has led some to call for other physical or even metaphysical hypotheses to explain the apparent "coincidence" that these constants are tuned to life-permitting values. Others have however questioned if such arguments are on sound footing. In your opinion what explains the values of physical constants and these so-called anthropic coincidences?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
The values of the constants are set by a principle (such as the "naturalness" principle forbidding a theory to have independent, fine-tuned parameters)	261 ± 16.2	15.7 ± 1.0
They are brute facts that need no further explanation	433 ± 20.8	26.0 ± 1.2
Explained by anthropic selection in a multiverse	332 ± 18.2	19.9 ± 1.1
Explained by a Darwinian process occurring in the cosmos (e.g., baby universes inside black holes)	104 ± 10.2	6.2 ± 0.6
Explained by an intelligent designer	148 ± 12.2	8.9 ± 0.7
Other	177 ± 13.3	10.6 ± 0.8
No opinion	210 ± 14.5	12.6 ± 0.9

7. Question 7: Quantum Mechanics Interpretations

Question. Quantum mechanics can provide exceptionally accurate predictions of real-world phenomena. Yet, physicists cannot explain how the reality we experience emerges from the laws of quantum mechanics—a question that many "interpretations" of quantum mechanics attempt to solve (for a quick review, check out this blog post). In your opinion, which interpretation of quantum mechanics is most likely to be correct?

Answer	Count (±1σ)	Percent (±1σ)
Copenhagen (an object's behavior is described by a multi-state wavefunction, which collapses to one state when an object is measured)	594 ± 24.4	35.7 ± 1.5
Many Worlds (the multi-state wavefunction splits into parallel universes when an object is measured)	183 ± 13.5	11.0 ± 0.8
Qbism (the multi-state wavefunction is subjective—a reflection of the information that an observer has collected)	153 ± 12.4	9.2 ± 0.7
Pilot Wave, or de Broglie–Bohm, theory (an unobservable wavefunction determines which state an object will occupy)	96 ± 9.8	5.8 ± 0.6
Collapse Theories (non-quantum mechanical processes, possibly involving gravity, lead to collapse of the wavefunction)	108 ± 10.4	6.5 ± 0.6
Consistent Histories (a proposal to determine which classical questions we can consistently ask of a quantum system)	87 ± 9.3	5.2 ± 0.6
Other	219 ± 14.8	13.2 ± 0.9
No opinion	223 ± 14.9	13.4 ± 0.9

8. Question 8: Matter Crossing an Event Horizon

Question. When a black hole gobbles up a star or planet or spaceship, the matter is thought to cross an "event horizon"—a boundary beyond which no signals can escape. In your opinion, what happens to the matter upon crossing this horizon?

Answer	Count (±1σ)	Percent (±1σ)
It is crushed into a singularity	672 ± 25.9	40.5 ± 1.5
A black hole is in reality a "fuzzball," a quantum object that doesn't have an event horizon.	237 ± 15.4	14.3 ± 0.9
It bounces out into our universe	81 ± 9.0	4.9 ± 0.5
It bounces out into another universe	106 ± 10.3	6.4 ± 0.6
Other	275 ± 16.6	16.6 ± 1.0

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
No opinion	287 ± 16.9	17.3 ± 1.0

9. Question 9: Black Hole Information

Question. The stuff that falls inside a black hole becomes stuck forever, or does it? Stephen Hawking and other physicists predicted that black holes slowly radiate thermal energy. But that poses a problem: the ingoing stuff has intrinsic properties (like quantum spin and quark flavors), and calculations predict that this information would not come back out in the emitted Hawking radiation. In other words, relativity seems to predict information is lost. Quantum mechanics, however, implies that information cannot be destroyed. In your opinion, what do you think is the correct description of the information that falls into a black hole?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
It's irretrievably lost	312 ± 17.7	18.8 ± 1.1
It's preserved in Hawking radiation	508 ± 22.5	30.5 ± 1.3
It's preserved in a remnant of the black hole	394 ± 19.8	23.7 ± 1.2
Other	173 ± 13.2	10.4 ± 0.8
No opinion	276 ± 16.6	16.6 ± 1.0

10. Question 10: Quantum Gravity Candidates

Question. Uniting quantum mechanics with gravity is one of the hardest problems facing physicists. So your last question, for extra credit: which is the best candidate for a theory of quantum gravity?

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
String Theory/M-Theory (replacing point particles with extended objects in higher dimensions)	315 ± 17.7	18.9 ± 1.1

Answer	Count ($\pm 1\sigma$)	Percent ($\pm 1\sigma$)
Loop Quantum Gravity (quantizing areas and volumes in spacetime)	212 ± 14.6	12.7 ± 0.9
Causal Sets (Discrete spacetime atoms, only connected by causal relations)	47 ± 6.9	2.8 ± 0.4
Horava–Lifshitz Gravity (breaking speed of light limit at high energies)	21 ± 4.6	1.3 ± 0.3
Causal Dynamical Triangulations (gluing triangulated space in layers of time)	16 ± 4.0	1.0 ± 0.2
Asymptotic Safety (spacetime becomes a fractal on small scales)	88 ± 9.4	5.3 ± 0.6
Gravity is not quantum	295 ± 17.2	17.7 ± 1.0
Other	192 ± 13.9	11.5 ± 0.8
No opinion	478 ± 21.9	28.7 ± 1.3

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